# SOME NEW GIVETIAN (LATE MIDDLE DEVONIAN) GASTROPODS FROM THE PAFFRATH AREA (BERGISCHES LAND, GERMANY)

JIRI FRÝDA

Frýda, J. 2000 06 30: Some new Givetian (late Middle Devonian) gastropods from the Paffrath area (Bergisches Land, Germany). *Memoirs of the Queensland Museum* **45**(2): 359-374. Brisbane. ISSN 0079-8835.

Revision of Givetian (Middle Devonian) gastropods from the Paffrath area (Bergisches Land, Germany) has identified a large number of new taxa described herein. These are *Retispira tasselli* sp. nov., *Stenoloron (Paffratholoron) goldfussi* subgen. et sp. nov., *Quadricarina (Blodgettina) reticulata* subgen. et sp. nov., *Kirchneriella* gen. nov., *Eiserhardtia inepta* gen. et sp. nov., *Cerithioides whidbornei* sp. nov., *Plagiothyra multispiralis* sp. nov., *Naticopsis (Paffrathopsis)* subgen. nov., *Paffrathia lotzi* gen. et sp. nov., *Cookiloxa pulchra* gen. et sp. nov., *Palaeozygopleura (Rhenozyga)* subgen. nov. and *Heteroloxonema* gen. nov. ❐ *Gastropods, Devonian, Givetian, Germany.*

*Jiri Frýda, Czech Geological Survey, Klárov 3, 118 21 Praha 1, Czech Republic, (fryda@cgu.cz); 14 January 2000.*

During the last fifteen years the number of studies on Devonian gastropods has increased rapidly (e.g., Blodgett & Rohr, 1989; Blodgett, 1992, 1993; Blodgett & Johnson, 1992; Kase & Nishida, 1986, 1988; Horný, 1992, 1994; Horný & Jordan, 1993; Frýda, 1992, 1998c,d, 1999b; Frýda & Manda, 1997; Frýda & Bandel, 1997; Gubanov et al., 1995; Cook, 1993, 1997; Cook & Camilleri, 1997; Bandel & Frýda, 1998). Impetus for increased interest in this relatively neglected group of Devonian fossils were the seminal studies of Blodgett et al. (1988, 1990) who identified the great potential utility of Palaeozoic gastropods as paleobiogeographic indicators. In addition, research focused on the higher taxonomy of the Devonian gastropods, based on protoconch morphology, has shown that during Devonian time a large change-over occurred from a fauna of typical Early Palaeozoic cast, to one of a more modern aspect (see Frýda, 1999a and references therein). Revision of the Givetian (Middle Devonian) gastropods from Germany (Frýda, 1998a) have identified a large number of new taxa and revised material untouched for up to 150 years (Goldfuss, 1844). The results of this revision have only partially been published (Bandel & Frýda, 1998, 1999; Frýda, 1998b, 1999a) and the majority of them have been prepared for monographic publication. Because new taxonomic names established in an unpublished study (Frýda, 1998a) are prepared to be used in non-taxonomic studies by other authors, there is a problem with their priority as well as the fact that some of them would be *nomina nuda*. For this reason, some new Givetian (Middle Devonian) gastropods from the Paffrath area (Bergisches Land, Germany) are established herein. Monographic treatment with detailed descriptions of all species belonging to newly established taxa as well as the evaluation of their palaeogeographical and stratigraphical distributions is in preparation (Frýda & Bandel, in prep.). All described gastropods come from the collection of Dr Volker Ebbighausen and are deposited in the Senckenberg Museum in Frankfurt au Main (Germany).

## SYSTEMATIC PALAEONTOLOGY

### AMPHIGASTROPODA Simroth, 1906
### BELLEROPHONTOIDEA M'Coy, 1851
### BELLEROPHONTIDAE M'Coy, 1851
### KNIGHTITINAE Knight, 1956

### **Retispira** Knight, 1945

TYPE SPECIES. *Retispira bellireticulata* Knight, 1945.

REMARKS. *Retispira* (Knight, 1945) is a complex genus within Knightitinae later regarded as a subgenus of *Knightites* Moore, 1941 (Knight et al., 1960). Batten (1972) suggested that *Retispira* represents a separate genus and this was followed by Gordon & Yochelson (1987). *Retispira* ranges from the Devonian to the Permian.

### **Retispira tasselli** sp. nov.
(Fig. 1F-J)

ETYMOLOGY. For the Australian paleontologist Chris Tassell.

MATERIAL. 6 specimens from Herrenstrunden, locality 9, Bergisches Land, Germany (coll. Ebbighausen). Holotype: figured herein as Fig. 1F,G

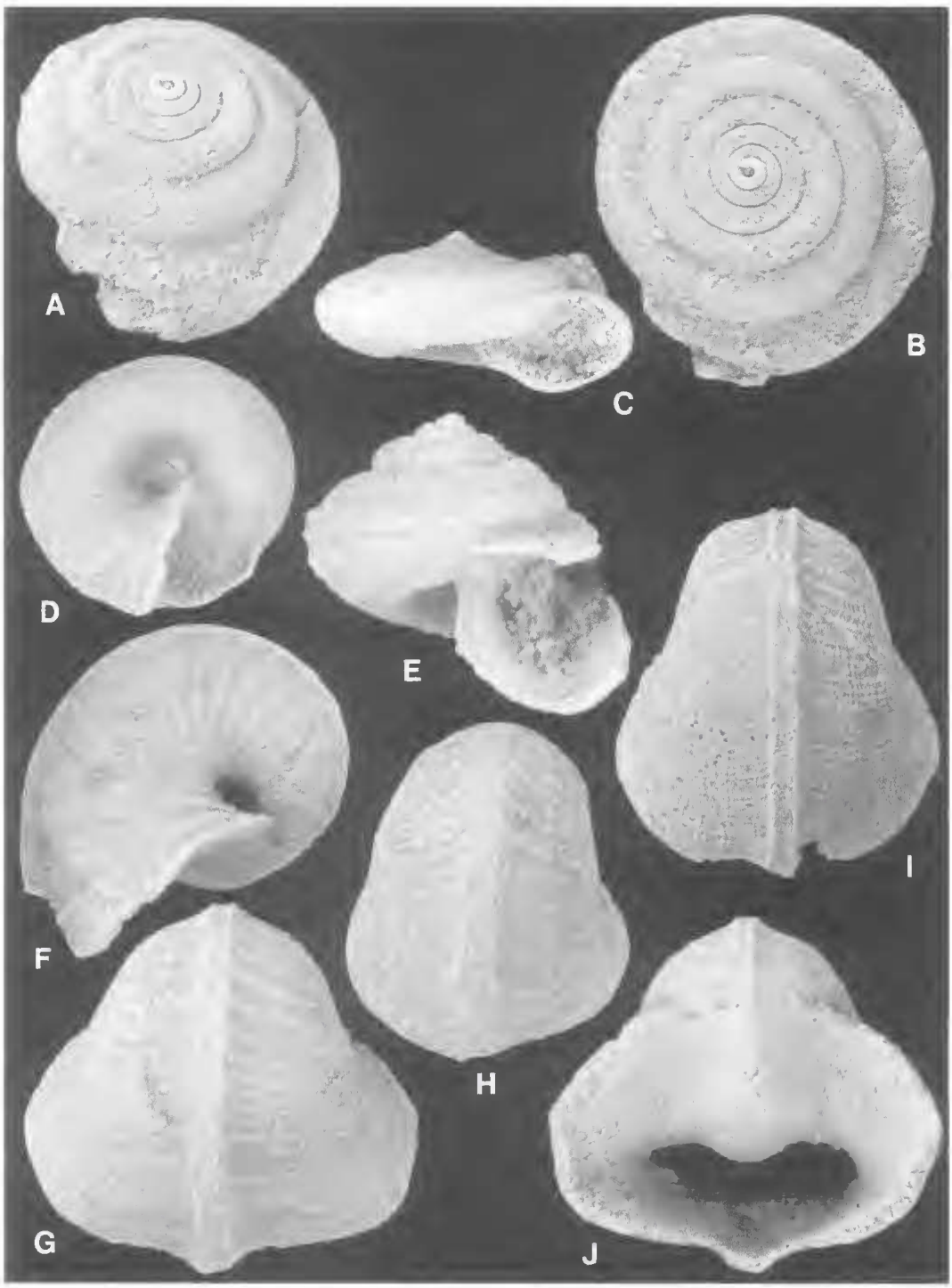


FIG. 1. A-C, *Stenoloron (Paffratholoron) goldfussi* sp. nov. A, Holotype, oblique view ×3.5; B, Holotype, apical view ×3.6; C, Paratype, apertural view ×3.8. D, E, *Quadricarina (Blodgettina) reticulata* sp. nov. D, Holotype, basal view showing a reticular pattern ×4; E, Holotype, apertural view ×5. F-J, *Retispira tasselli* sp. nov. F, Holotype, lateral view showing a shell ornamentation ×4.8; G, Holotype, dorsal view ×4.8; H, Paratype A, dorsal view ×7; I, Paratype B, dorsal view ×4.5; J, Paratype C, apertural view ×5.

TYPE LOCALITY. Bücheler Schichten, Middle Devonian (Givetian), Herrenstrunden, Bergisches Land, Germany.

DIAGNOSIS. Species of *Retispira* with small shell having a broad, flat selenizone raised above the shell dorsum; shell narrowly and deeply phaneromphalous; lateral portions of whorl profile rounded into narrow umbilici without any angulation; apertural lip of mature whorl is slightly expanded on its lateral and umbilical portions; shell ornament consisting of spiral and collabral lirae forming a reticulate pattern of longitudinally elongated rectangles.

DESCRIPTION. Small bellerophontid shell bearing a broad, flat selenizone raised above shell dorsum. Shell narrowly and deeply phaneromphalous. Whorl profile slightly concave on each side of selenizone and gently convex in dorsolateral portions. Lateral portions of whorl profile curve into narrow umbilici without any angulation. Shallow and wide sinus in anterior margin of the outer lip culminates in a slit generating a raised selenizone. Selenizone bounded by two distinct spiral threads; width of the selenizone about 15% of width of shell dorsum. Apertural lip of the mature whorl slightly expanded on its lateral and umbilical portions. Shell ornament consists of spiral and collabral lirae; collabral lirae widely spaced and more expressed than closely spaced spiral lirae; spiral lirae crossing the collabral lirae form a reticulate pattern of longitudinally elongate rectangles. Distances of both spiral and collabral lirae vary considerably during the ontogeny.

REMARKS. *Retispira tasselli* resembles *Retispira leda* (Hall, 1861) from the Middle Devonian of North America in its similar whorl expansion in the adult whorl. However, *R. tasselli* sp. nov. differs by having a narrower shell, raised selenizone and by the absence of ornamentation of its selenizone. *Bellerophon elegans* de Ferussac & Orbigny, 1840 noted by Archiac & Verneuil (1842: 354, pl. 29, fig. 2) from the Paffrath region is similar to *Retispira tasselli* and most probably also belongs in *Retispira*. It is distinguished from the latter by the absence of a raised selenizone. *Retispira tasselli* is also similar to *Retispira* sp. of Blodgett (1992) from the Eifelian of Alaska, but may be distinguished by its more raised selenizone.

Rollins et al. (1971) discussed similarities of *Retispira* and *Bucanopsis* which have similar shell shapes. *Merriamites* Blodgett & Johnson, 1995 (=*Merriamella* Blodgett & Johnson, 1992, previously occuppied homonym), based on the Middle Devonian species *Merriamites eurekae* from Nevada, is also similar to *Retispira* in having a reticulate ornamentation. *Merriamites* differs from *Bucanopsis*, the latter having an ornament of spiral threads, in having a much broader longitudinal keel on the inner floor of the whorl, a prominent reticulate pattern and a prominent, rounded parietal tooth. The presence of a keel on the inner floor of the whorl is a character by which *Bucanopsis* and *Merriamites* (both are placed in Carinaropsinae) differ from *Retispira*. Similarities in these genera with some Knightitinae were also noted by Blodgett & Johnson (1992).

ARCHAEOGASTROPODA Thiele, 1925
GOSSELETINIDAE Wenz, 1938

**Stenoloron** Oehlert & Oehlert, 1888
**Stenoloron (Paffratholoron)** subgen. nov.

TYPE SPECIES. *Stenoloron (Paffratholoron) goldfussi* sp. nov.

ETYMOLOGY. *Paffratholoron*, for the type locality.

DIAGNOSIS. Subgenus of *Stenoloron* Oehlert & Oehlert, 1888 having low spired, phaneromphalous shell with slowly expanding whorls.

REMARKS. *Stenoloron (Paffratholoron)* subgen. nov. has slowly expanding whorls. The distance of the upper suture from the shell periphery (measured in the apical view) is about 15% of its total shell width. This value is double (i.e. 30%) in the generic type species, *Stenoloron vienuayi* (Oehlert & Oehlert, 1888). In addition, Devonian species of *Stenoloron* Oehlert & Oehlert, 1888, such as *Stenoloron subaequitera* (Chapman, 1916) from the Early Devonian of Australia, *Stenoloron minor* Blodgett & Johnson, 1992, from the Middle Devonian of North America, and *Stenoloron pollens* Perner, 1903 from the Early Devonian of Europe have similar values of whorl expansion as the type species (i.e. about 30%). For this reason the species described below is placed in a new subgenus.

**Stenoloron (Paffratholoron) goldfussi** sp. nov.
(Fig. 1A-C)

ETYMOLOGY. For the German paleontologist August Goldfuss, who studied Devonian gastropods of the Paffrath area.

MATERIAL. 3 specimens from Unterthal, Paffrath area, Bergisches Land, Germany (coll. Ebbighausen). Holotype: figured herein as Fig. 1A,B.

TYPE LOCALITY. Unterer Plattenkalk, Middle Devonian (Givetian), Unterthal, locality 63, Bergisches Land, Germany.

DIAGNOSIS. As for subgenus.

DESCRIPTION. Small, turbiniform shell with a wide umbilicus, width about one quarter of total shell width. Width of shell having about 7 whorls measures about 15mm. Sides of shell slightly convex (i.e. cyrtoeonoid) due to deerease of the pleural angle in the last two whorls. Narrow, slightly convex selenizone situated high on the whorl bounded by a single shallow groove on the each side. Whorl profile above the selenizone rounded and nearly subhorizontal at the upper suture; sutures are shallow. Suture just below its selenizone in younger whorls; in the mature whorl, the distance of the lower groove bounding the selenizone and the lower suture is about one half of selenizone width. Shell surface smooth.

The initial portion of the shell is lost in the holotype but it is preserved in another speeimen from the same loeality figured herein as Fig. 1C. The high spired early whorls distinetly protrude above the upper, convex shell surfaee. During the further shell growth, the pleural angle continually increases, but in the last two whorls it again slightly decreases. For this reason the sides of the early shell are concave and slightly convex in the mature shell.

REMARKS. *Stenoloron (Paffratholoron) goldfussi* sp. nov. is the only speeies assigned to the subgenus. It is distinguished from the species of *Stenoloron (Stenoloron)* by shape of its many-whorled shell and characteristic slow expansion. The selenizone in *Stenoloron (Paffratholoron) goldfussi* sp. nov. is wider than in the generic type speeies *Stenoloron (Stenoloron) viennayi* and *Stenoloron (Stenoloron) subaequitera* (Chapman, 1916), but is simliar in width to *Stenoloron (Stenoloron) minor* Blodgett & Johnson, 1992. *Stenoloron (Paffratholoron) goldfussi* represents the youngest oceurrenee of the genus, previously reported from the Early Devonian and Silurian. The only other Middle Devonian species known is *Stenoloron (Stenoloron) minor* Blodgett & Johnson, 1992 from the Eifelian of central Nevada.

EOTOMARIIDAE Wenz, 1938

**Quadricarina** Blodgett & Johnson, 1992
**Quadricarina (Blodgettina)** subgen. nov.

TYPE SPECIES. *Quadricarina (Blodgettina) reticulata* sp. nov.

ETYMOLOGY. For the American paleontologist Robert B. Blodgett.

DIAGNOSIS. Similar to *Quadricarina (Quadricarina)*, with low spired shell having distinctly raised selenizone above the whorl surface; shell ornament consisting of reticulate pattern.

REMARKS. *Quadricarina* Blodgett & Johnson, 1992 is represented by four Middle Devonian speeies. Three species, ineluding its type species *Quadricarina glabrobasis* Blodgett & Johnson, 1992, come from the Eifelian of Nevada. Blodgett & Johnson (1992) also include *Pleurotomaria lenticularis* Goldfuss, 1844 from the Givetian of Germany. The turbiniform, phaneromphalous shells of *Quadricarina* species are characterised by a selenizone bordered by two pairs of revolving cords. A gently concave selenizone is situated at mid-whorl height. Shell ornament consists of fine collabral ribs. *Quadricarina (Blodgettina)* subgen. nov., is similar to hitherto known species of *Quadricarina (Quadricarina)* in general shell shape and the position of the selenizone, but differs in having a distinctly raised selenizone above the whorl surface and reticulate shell ornament.

**Quadricarina (Blodgettina) reticulata** sp. nov.
(Fig. 1D,E)

ETYMOLOGY. In reference to the presence of reticulate ornamentation.

TYPE LOCALITY. U. Plattenkalk limestones, Middle Devonian (Givetian), Unterthal, locality 63, Bergisches Land, Germany.

MATERIAL. 10 specimens from Unterthal, locality 63, Bergisches Land, Germany (coll. Ebbighausen). Holotype: figured herein as Fig. 1D,E.

DIAGNOSIS. As for subgenus.

DESCRIPTION. Small, turbiniform shell with a selenizone situated at shell periphery. Mature spire consisting of about six whorls, width approximately 13mm. Outer lip of aperture forms a shallow sinus culminating in a peripheral carina that gives rise to a flat selenizone; selenizone distinctly protruding above whorl surfaee. Selenizone bordered by two pairs of revolving cords; outer pair forming its margin and inner pair spaeed between outer cords. Inner cords always slightly thinner than the outer cords. Very narrow groove between the inner eords. Upper and lower whorl surfaees convex; sutures deep and impressed. Whorl profile below selenizone forms a rounded shell base with a deep, funnel-

like umbilicus. Width of umbilicus about one quarter of total shell width. Whorls embrace below the selenizone. Distance between lower margin of selenizone and lower suture greater than width of the flat, protruding selenizone. Shell ornament above and below spiral and collabral threads forming a reticulate pattern. About 25 spiral threads below the selenizone form small tubercles where they are crossed by collabral threads.

REMARKS. *Quadricarina (Blodgettina) reticulata* subgen. et sp. nov. may be distinguished from all species of *Quadricarina (Quadricarina)* by the presence of peripheral carina bearing a selenizone and by its reticulate ornamentation. However, it resembles *Quadricarina* sp. nov. B of Blodgett & Johnson (1992) in its low-spired shell, wide umbilicus and slightly raised, carinate periphery but differs by having the selenizone distinctly situated above the suture, and having reticulate ornament. Whorls embrace slightly above the selenizone in *Quadricarina* sp. nov. B. The carinate periphery suggests that the poorly known *Quadricarina* sp. nov. B may belong to *Quadricarina (Blodgettina)*.

RAPHISTOMATIDAE Koken, 1896
OMOSPIRINAE Wenz, 1938

**Kirchneriella** gen. nov.

TYPE SPECIES. *Turbo striatus* Hisinger in Goldfuss, 1844.

ETYMOLOGY. For the German paleontologist Heinrich Sylvester Kirchner, who in 1915 published 'Mitteldevonische Gastropoden von Soetenich in der Eifel'.

DIAGNOSIS. Turbiniform, relatively low-spired shell with a very indistinct selenizone situated high on the whorls; lateral side of whorls rounded; shell ornament consisting only of spiral cords; spiral cords on the phaneromphalous shell base generally regularly spaced; more closely spaced than those on the upper whorl surface; a spiral cord is also present on the selenizone surface.

REMARKS. *Kirchneriella* gen. nov. closely resembles the Permian *Callistadia* Knight, 1945 in general shell shape, position of the indistinct selenizone and shell ornament. Carboniferous and Permian species of *Callistadia* may be distinguished from *Kirchneriella* gen. nov. by the shape of the lateral whorl profile which is rounded in *Kirchneriella*, but nearly vertical and straight or gently concave in *Callistadia* (see Knight, 1945; Hoare & Sturgeon, 1978). *Kirchneriella* also shows some similarities with the type species of *Gyroma* Oehlert, 1888, *Pleurotomaria baconnierensis* (Oehlert, 1888), from the Lower Devonian of France, however this species has collabral and spiral ornaments, in contrast to *Kirchneriella*. Nevertheless, some Devonian species assigned to *Gyroma*, like the Frasnian *Gyroma altaica* (Verneuil, 1845) and *Gyroma subcapillaria* Vostokova, 1966, lack collabral ornament and probably belong to *Kirchneriella*. Blodgett (1992) noted the first occurrence of pre-Carboniferous *Callistadia* in Middle Devonian rocks (Eifelian of Alaska). Unfortunately, only two, poorly preserved specimens are known, preventing determination of whether they belong to *Callistadia* or to *Kirchneriella*. The Middle Devonian *'Turbo' multistriatus* Kirchner, 1915 and *'Turbo' aequistriatus* Kirchner, 1915 may belong to *Kirchneriella*, but need to be restudied in detail. *Kirchneriella striata* (Hisinger in Goldfuss, 1844) is the only known species of this genus.

Family UNCERTAIN

**Eiserhardtia** gen. nov.

TYPE SPECIES. *Eiserhardtia inepta* sp. nov. by monotypy.

ETYMOLOGY. For the German paleontologist Klaus Eiserhardt for his kind help with SEM photos.

DIAGNOSIS. Discoidal shell having a very wide and flat selenizone which forms the whorl periphery; shell base phaneromphalous; width of umbilicus about one quarter of the shell width; selenizone of younger whorls is situated in distinct, U-shaped groove close to upper suture; upper suture forms abapical margin of the selenizone; shell ornamentation consisting of spiral and collabral elements forming a reticular pattern.

REMARKS. *Eiserhardtia inepta* sp. nov. is distinguished by its U-shape groove opening of the selenizone on the preceding whorl (Fig. 2G). In addition, the very wide and flat selenizone forming the whorl periphery is not common among Palaeozoic gastropods. *Eiserhardtia* resembles some Palaeozoic genera like the Ordovician *Latitaenia* Koken, 1925, *Chepultapecia* Ulrich in Weller & Clair, 1928, and *Liospira* Ulrich & Scofield, 1897 and the Devonian *Umbotropis* Perner, 1903 in general shell shape. However, the unusual subsutural groove easily differentiates it from all these genera.

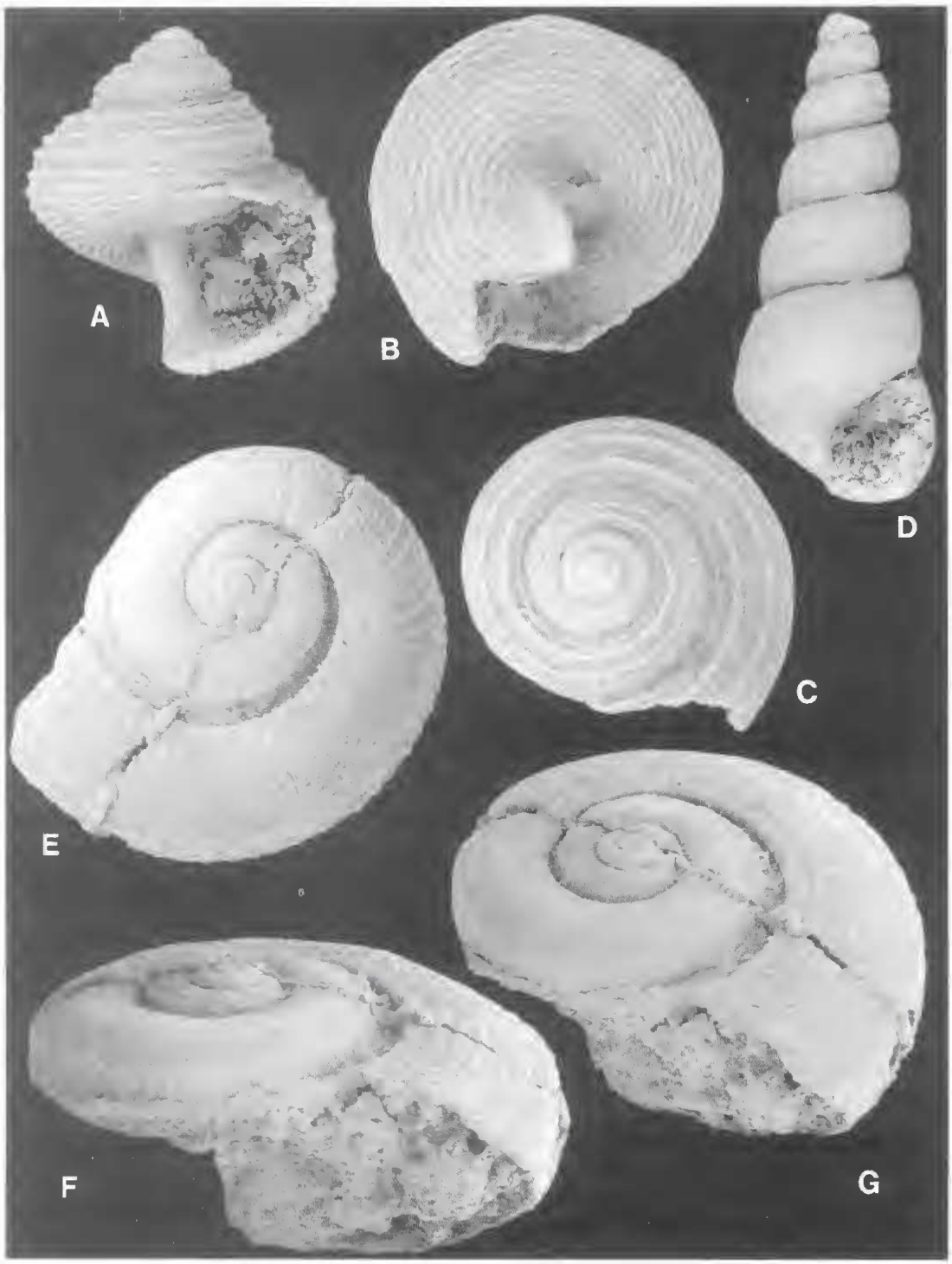


FIG. 2. A-C, *Kirchneriella striata* (Hisinger in Goldfuss, 1844); A, apertural view ×4.5; B, basal view showing a spiral ornamentation, same shell as A, ×3.6; C, apical view ×5. D, *Cerithioides whidbornei* sp. nov., lateral view ×3.8. E-G, *Eiserhardtia inepta* sp. nov., Holotype; E, apical view showing shell ornamentation ×11; F, apertural view ×13; G, oblique view showing a subsutural groove ×13.

**Eiserhardtia inepta** sp. nov.
(Fig. 2E-G)

ETYMOLOGY. Latin, *ineptus*, inept, unable.

MATERIAL. Only one complete shell, Unterthal, locality 63, Bergisches Land, Germany (coll. Ebbighausen). Holotype: figured herein as Fig. 2E-G.

TYPE LOCALITY. U. Plattenkalk limestones, Middle Devonian (Givetian), Unterthal, locality 63, Bergisches Land, Germany.

DIAGNOSIS. As for genus.

DESCRIPTION. Medium-sized, dextrally coiled, discoidal shell with a wide and flat selenizone situated at the shell periphery. Mature spire with about four whorls; width more than double its height. Outer lip of aperture forms a shallow sinus culminating at a peripheral selenizone. Selenizone parallel with shell axis and ornamented by irregularly spaced lunulae. Width of flat selenizone about one quarter of the whorl height. Outline of aperture elliptical with longer axis roughly perpendicular to shell axis. Whorl profile above selenizone slightly convex, except close to the upper suture where it forms a U-shaped groove. Selenizone of younger whorls situated in this U-shaped groove (Fig. 2G); upper suture just below selenizone. Width of umbilicus about a quarter of the total shell width. Shell ornament consists of spiral and collabral threads forming a reticulate pattern. About 15 regularly spaced, spiral threads on the shell above the selenizone are crossed by backward curving collabral threads.

MURCHISONIIDAE Koken, 1896

**Cerithioides** Haughton, 1859

TYPE SPECIES. *Cerithioides telescopium* Haughton, 1859.

REMARKS. *Cerithioides telescopium*, was described from the Carboniferous of Ireland. Donald (1892) placed in its synonymy two additional Carboniferous species, *Murchisonia maxima* and *Glyptobasis conica*, both earlier described by de Koninck (1883). Batten (1966), who revised the type species of *Cerithioides*, expressed the opinion that *Cerithioides conicus* (de Koninck) is an independent species having *Cerithioides maximus* (de Koninck) as a junior synonym. He also agreed with Donald's placement of *Murchisonia (Cerithioides?) oweni* Donald, 1895 into *Cerithioides* and additionally placed *Cerithioides? gleanensis* Longstaff, 1926 into synonymy with this species. Batten (1966) placed *Murchisonia eversolensis* Stauffer, 1909 from the Middle Devonian of Ohio into *Cerithioides* and considered it to be the earliest representative of the genus. Small shells of *Cerithioides incomptum* Linsley, 1968 from the Middle Devonian of the North America probably do not belong to *Cerithioides*. *Cerithioides whidbornei* sp. nov. has a similar whorl profile to *C. eversolensis* (Stauffer,1909) and also lacks the spiral costae on shell base. Both species may belong to a new subgenus within *Cerithioides* using the latter characters differing them from the Carboniferous *Cerithioides* species.

**Cerithioides whidbornei** sp. nov.
(Fig. 2D)

ETYMOLOGY. For the British paleontologist G.F. Whidborne who contributed much to our knowledge of the Devonian gastropods.

MATERIAL. 10 specimens from the type locality (coll. Ebbighausen). Holotype: figured herein as Fig. 2D.

TYPE LOCALITY. Middle Devonian (Givetian) limestones, Bergisch Gladbach, locality 65, Bergisches Land, Germany.

DIAGNOSIS. Species of *Cerithioides* lacking spiral costae on the shell base; wide selenizone situated in the middle of whorl.

DESCRIPTION. High-spired, dextrally coiled shell with almost straight sides. Whorl profile distinctly convex close to both upper and lower sutures and nearly flat or slightly concave at the mid-whorl. Suture moderately deep. Shell base rounded and anomphalous. Wide selenizone situated at mid-whorl with width about 20% of the distance between the lower and upper sutures. Outer apertural lip bears a wide sinus culminating in a wide slit. Margins of apertural sinus form an angle of about 90°. Inner lip covered by thin inductura. Ornamentation consists only of growth lines. Selenizone limited by a fine, spiral groove on each side and ornamented by irregularly spaced lunulae.

REMARKS. *Cerithioides whidbornei* sp. nov. may be distinguished from *Cerithioides eversolensis by the position of the selenizone. In C. whidbornei*, the wide selenizone is situated mid-whorl, however, in *C. eversolensis* (Stauffer, 1909) it is distinctly below mid-whorl. Its upper margin runs closely to mid-whorl and the distance between its lower margin and the lower suture is smaller than the width of the selenizone (see Stauffer, 1909, pl. 16, fig. 13). *Cerithioides*

*whidbornei* sp. nov. may be also distinguished from the type species *C. telescopium* Haughton, 1859, by the absence of spiral costae on its shell base. *Cerithioides oweni* Donald, 1895, differs from both Devonian species and the type species by its whorl profile which has a distinct angulation below the selenizone (see Donald, 1895: pl. 10, figs 1, 1a).

NERITIMORPHA Golikov & Starobogatov, 1975
NERITOIDEA Rafinesque, 1815
PLAGIOTHYRIDAE Knight, 1956

**Plagiothyra** Whidborne, 1892

TYPE SPECIES. *Monodonta purpurea* Archiac & Verneuil, 1842.

REMARKS. Whidborne (1892) established *Plagiothyra* for species *Monodonta purpurea* Archiac & Verneuil, 1842 and his new species *Plagiothyra archon* Whidborne, 1892. The latter was described from the Middle Devonian of southwest England. Vostokova (1966) suggested a placement of the species *Palaeotrochus praecursor* Clarke, 1885 into *Plagiothyra*, but earlier Vostokova (1961) had established *Pseudoplagiothyra* for that species. Two new undescribed species of *Plagiothyra* occur in the Devonian of the North America (R.B. Blodgett, pers. comm.); one in the Eifelian age Cheeneetnuk Limestone of the west-central Alaska and a second species in the Emsian age Disappointment Bay Formation, Canadian Arctic Islands. The last species is the first Early Devonian occurrence, and thus the oldest representative of *Plagiothyra*.

**Plagiothyra multispiralis** sp. nov.
(Fig. 3E-H)

ETYMOLOGY. *multispiralis*, referring to the shell ornamentation formed by many spiral threads.

MATERIAL. More than 30 specimens from the Unterthal, locality 63, Bergisches Land, Germany (coll. Ebbighausen). Holotype: figured herein as Fig. 3GH.

TYPE LOCALITY. U. Plattenkalk limestones, Middle Devonian (Givetian), Unterthal, locality 63, Bergisches Land, Germany.

DIAGNOSIS. Species of *Plagiothyra* ornamented by many spiral threads; plate-like ridge bearing a triangular tooth within aperture smaller than in type species.

DESCRIPTION. Dextrally coiled, turbiniform shell with a rapidly expanding whorls, shell height about 15mm. Shell base anomphalous, sutures shallow and adpressed. Whorl profile shows distinctly stronger convexity near upper suture where it forms a small ramp. Whorls join the preceding whorl below its periphery. The margin of the outer apertural lip passes downward from the upper suture with strong backward obliquity, but without any curvature. Columellar lip covered by a thick inductura. Prominent, triangular tooth occurs on a very low platelike ridge in the middle of the parietal wall. Shell ornamentation consists of many spiral threads that may be crossed by fine growth lines. Number of spiral threads between the sutures is about 20. Threads more distinct on adapical part of outer whorl surface.

REMARKS. *Plagiothyra multispiralis* sp. nov. differs from the type species, *Plagiothyra purpurea* Archiac & Verneuil, 1842, by having a lower-spired shell that is ornamented by many spiral threads. Shell ornamentation on *Plagiothyra purpurea* consists of several distinct rows of tubercles. The number of spiral elements between the sutures is about 20 in *Plagiothyra multispiralis* sp. nov., but only 8 in *Plagiothyra purpurea*. Shell ornament on *P. multispiralis* resembles that of the other two genera in the family Plagiothyridae, *Dirachis* Whidborne, 1891, and *Littorinides* Knight, 1937. However, shells of the Middle Devonian *Dirachis*, being ornamented by a lower number of more distinct spiral elements, bear two teeth in the aperture. The Carboniferous *Littorinides* has one low tooth on the columellar lip in contrast *Plagiothyra multispiralis* sp. nov. The similar shape of the apertural tooth and its position within the aperture, as well as the similar shell shape of *P. purpurea* and *P. multispiralis*, necessitate placement of the new species in the *Plagiothyra*.

NERITOPSIDAE Gray, 1847
NATICOPSINAE Miller, 1889

**Naticopsis** M'Coy, 1844
**Naticopsis (Paffrathopsis)** subgen. nov.

TYPE SPECIES. *Natica subcostata* Archiac & Verneuil, 1842.

ETYMOLOGY. For the type area, Paffrath, Germany.

DIAGNOSIS. *Naticopsis* having moderately low spired shells with strong collabral cords extending across entire whorl surface.

REMARKS. Yochelson (1953) placed *Natica subcostata* Archiac & Verneuil, 1842 into *Naticopsis (Jedria)* based on the Carboniferous

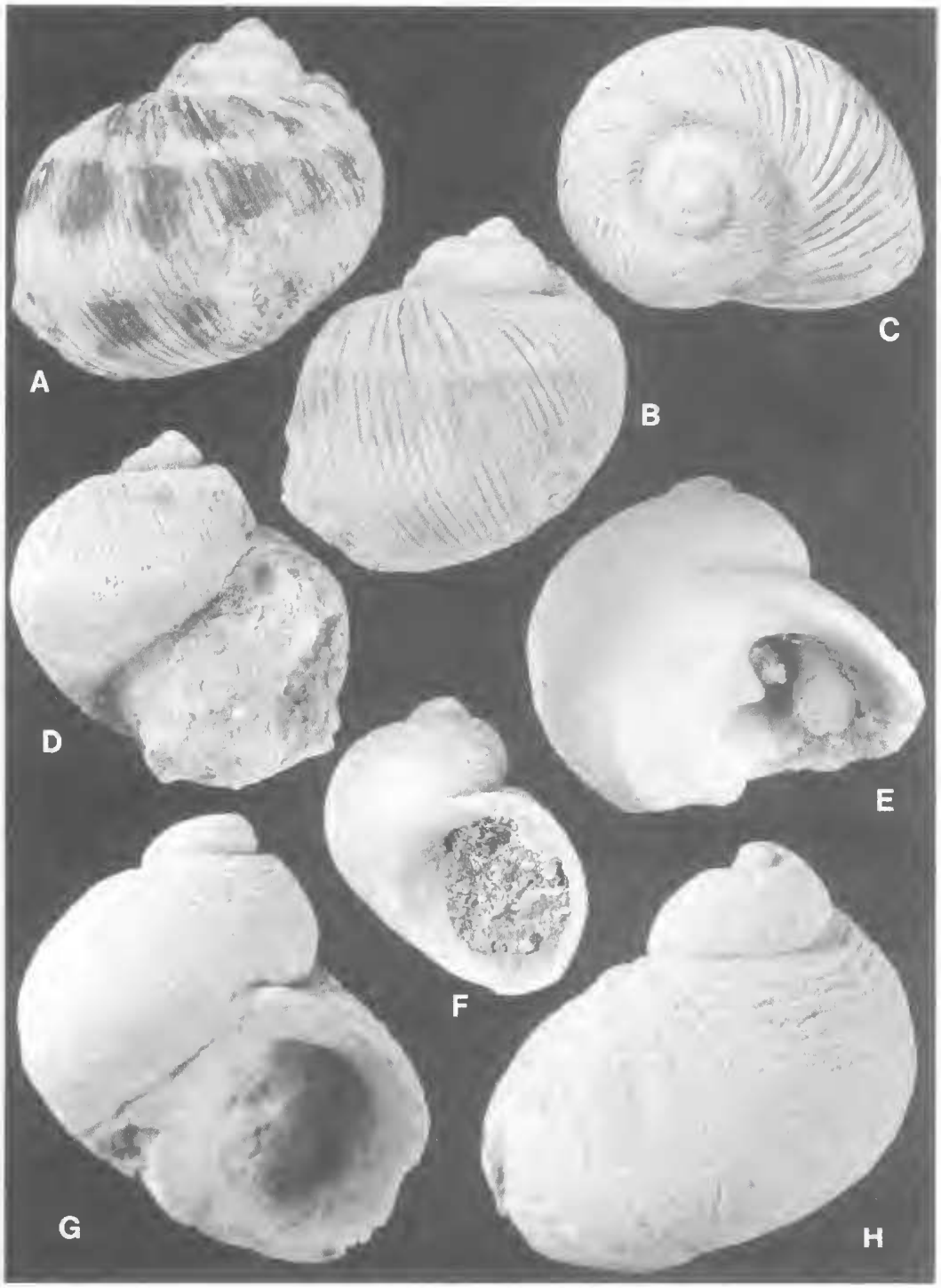


FIG. 3. A-D, *Naticopsis (Paffrathopsis) subcostata* (Archiac & Verneuil, 1842); A, abapertural view of shell with well preserved colour pattern ×3.3.; B, same shell covered with ammonium chloride ×3.3; C, apical view ×3; D, apertural view ×3. E-H, *Plagiothyra multispiralis* sp. nov.; E, Paratype A, apertural view showing a triangular tooth on low platelike ridge of the parietal wall ×7; F, Paratype B, apertural view ×3.5. G, Holotype, apertural view ×5; H,Holotype, abapertural view ×5.

*Naticopsis meeki* Knight, 1933. *Naticopsis (Jedria) subcostata* was the only Devonian species placed into *Naticopsis (Jedria)*. Blodgett (1992) described *Naticopsis (Jedria) deckeri* from the Eifelian (Middle Devonian) of Alaska which is the oldest representative of this subgenus. Gordon & Yochelson (1987) noted that the body whorl extended downward rather than outward, and that the swelling on the outer whorl face above the periphery indicates the subgenus *Jedria*. All these shell characters may be seen in the Carboniferous species of *Naticopsis (Jedria)* as well as in *Naticopsis (Jedria) deckeri*, but not in *Natica subcostata* Archiac & Verneuil, 1842. *N. subcostata* has a moderately low spired shell with strong collabral cords extending across the entire whorl surface. These shell characters distinguish this species from all species included in *Naticopsis (Jedria)* as well as from other subgenera of *Naticopsis*. *Naticopsis (Paffrathopsis) subcostata* is the only species currently known.

**Naticopsis (Paffrathopsis) subcostata**
(Archiac & Verneuil, 1842)
(Fig. 3A-D)

non *Buccinites subcostatus*, Schlotheim 1820: 130; Schlotheim 1822: 63, pl. 12, fig. 3.
*Natica subcostata*, 1842: 366, pl. 34, figs 5, 5a, 6; Goldfuss 1844: 116, pl. 198, fig. 22.
*Turbonitella subcostata* (Archiac & Verneuil) Lotz 1900: 212; Kirchner 1915 (partim): 238; Paeckelmann 1922: 41.

MATERIAL. Five complete shells and several fragments from the Unterthal, locality 63, and one complete shell from Bergisch Gladbach, locality 76, Bergisches Land, Germany (coll. Ebbighausen).

REMARKS. Goldfuss (1844) synonymised the species *Buccinites subcostatus* Schlotheim, 1820 and *Natica subcostata* Archiac & Verneuil, 1842. However, Schlotheim's figure (see Schlotheim, 1822, pl. 12, fig. 3) of *Buccinites subcostatus* differs from that of *Natica subcostata* (compare with Archiac & Verneuil, 1842, pl. 34, figs 5, 6). Material from Paffrath evidently belongs to the species *Natica subcostata* Archiac & Verneuil, 1842, which is the first unquestionable illustration of this species. For this reason, Archiac & Verneuil's name is considered to be a valid species name.

*Colour Pattern*. Traces of original colour pattern in *Naticopsis (Paffrathopsis) subcostata* (Archiac & Verneuil, 1842) were observed in specimens from Unterthal, locality 63, and Bergische Gladbach, locality 76. The geometry of the colour pattern in specimens from the both localities is the same. The colour pattern consists of three spiral bands of black irregular spots (Fig. 3A). The distance between the spots in each band is about equal to their diameter. The whorl surface close to the upper suture is without any colour. Archiac & Verneuil (1842: pl. 34, figs 5, 6) and Roemer (1876: pl. 32, fig. 8) figured the same colour pattern as described herein in their figures of *Natica subcostata* (=*Naticopsis (Paffrathopsis) subcostata*).

**Paffrathia** gen. nov.

TYPE SPECIES. *Paffrathia lotzi* sp. nov.

ETYMOLOGY. For the type area, Paffrath, Germany.

DIAGNOSIS. Small, low spired turbiniform shell ornamented by strong, sharp collabral ribs extending across the entire whorl surface; shell wall very thick; whorl profile suboval.

REMARKS. Characteristic shell ornament consisting of the distinct collabral ribs (Fig. 4A, B) distinguishes *Paffrathia* from all Palaeozoic members of the family Neritopsidae. Absence of spiral elements and the presence of distinct collabral elements of the shell ornamentation have complicated the subfamily-level position of *Paffrathia* gen. nov. as well as *Naticopsis (Paffrathopsis) subcostata* (Archiac & Verneuil, 1842) within the Neritopsidae. According to Knight et al. (1960) the Naticopsinae unites shells without ornament (except for subsutural collabral threads or cords in some species). On the other hand, Palaeozoic members of the Neritopsinae are ornamented with pustules. Only the type species *Paffrathia lotzi* sp. nov. is known.

**Paffrathia lotzi** sp. nov.
(Fig. 4A,B)

*Turbonitella* sp.?, Lotz, 1900: 213, pl. 3, fig. 8.

ETYMOLOGY. For H. Lotz who originally figured this species.

MATERIAL. One complete shell from the Unterthal, locality 63, Bergisches Land, Germany (coll. Ebbighausen). Holotype: figured herein as Fig. 4A,B.

TYPE LOCALITY. U. Plattenkalk limestones, Middle Devonian (Givetian), Unterthal, locality 63, Bergisches Land, Germany.

DIAGNOSIS. As for genus.

DESCRIPTION. Small, low spired turbiniform shells with at least four whorls. Whorl profile convexly arched. Height of the adult shell approximately equals width. Whorls embrace near base. Inner whorl profile suboval, sutures

very deep. Whorl profile runs from the upper suture laterally for short distance to rounded spiral angulation, far from this angulation it curves downward forming convex lateral part of the whorl, and then continues across the rounded whorl base into deep umbilicus. Outer apertural lip is prosocline. Shell wall in adult whorl is relatively thick; about 20% of inner apertural diameter. Shell ornament consists of strong, sharp collabral ribs extending across the entire whorl surface. Ribs regularly spaced and their distance roughly equals half of the diameter of the aperture. Fine growth lines may be observed on the surface between collabral ribs.

REMARKS. *Paffrathia lotzi* is a rare element of gastropod fauna of the Givetian (Middle Devonian) U. Plattenkalk limestones of Germany, with the illustrated specimen (Fig. 4A,B) the only shell available for study. The specimen figured by Lotz (1900: pl. 3, fig. 8) seems to belong to this species. However, a larger collection of this species is needed for the study of shell variability.

? LOXONEMATOIDEA
Koken, 1889

**Cookiloxa** gen. nov.

ETYMOLOGY. For the Australian paleontologist Alex Cook.

TYPE SPECIES. *Cookiloxa pulchra* sp. nov.

DIAGNOSIS. Slender, regular, high-spired and multiwhorled shell with straight sides having a gently convex whorl profile; sutures deep, whorls more arched close to both upper and lower sutures; external surface of whorls ornamented by collabral costae which are asymmetrically bent and crossed in the mid-whorl by one spiral costa.

REMARKS. *Cookiloxa* resembles *Australoxa* Cook & Camilleri, 1997 in its shell ornamentation. The latter genus is based on *Australoxa tasselli* Cook & Camilleri, 1997 from the Middle Devonian of Australia. The angular whorls of *A. tasselli* are ornamented by prominent opisthocline ribs and a low, sharp sinus is developed on the angular whorl periphery (see Cook & Camilleri, 1997: fig. 9E-L). One spiral cord occurs just above the lower suture. *Cookiloxa* gen. nov. differs from *Australoxa* in having a rounded whorl profile, a much smaller shell and by the absence of a peripheral sinus and lower spiral cord. *Cookiloxa* also resembles the Permian genera *Loxosonia* Batten, 1985 and *Cibecuia* Winters, 1963 in shell ornament. Batten (1985) interpreted the spiral groove-like element of their shell ornamentation as a selenizone. *Cookiloxa* differs from *Cibecuia* by a different whorl profile, being distinctly convex in contrast to the latter genus which has a flat whorl profile. *Cookiloxa* has a similar whorl profile as both known species of *Loxosonia*, i.e. *Loxosonia horrmotoma* Batten, 1985 and *Loxosonia zygopleuroides* Batten, 1985. *Cookiloxa* may be distingushed from both species of *Loxosonia* by the position of its spiral element of shell ornamentation. In *Cookiloxa* costa-like spiral element is situated in the middle of the whorl, but in *Loxosonia* the groove-like spiral element (?= selenizone) occurs close to the upper suture. *Cookiloxa* also resembles the Ordovician genera *Spiroecus* Longstaff, 1924 and *Donaldiella* Cossmann, 1903. *Spiroecus* Longstaff, 1924, differs from *Cookiloxa* in having a more prominent spiral ornamental element being situated above the mid-whorl and forming a distinct angulation (see holotype in Knight, 1941: pl. 48, fig. 10). In addition *S. girvanensis* differs from *Cookiloxa pulchra* by the absence of collabral costae (but see specimen figured by Wenz, 1938: fig. 929b). *Cookiloxa* may be distinguished from the genus *Donaldiella* by its differing shape of the whorl profile and outer apertural lip. The Middle Devonian *Cookiloxa pulchra* sp. nov. from Germany is the only known species.

**Cookiloxa pulchra** sp. nov.
(Fig. 4C,D)

ETYMOLOGY. Latin, *pulcher*, beautiful.

MATERIAL. About 30 specimens from the Herrenstrunden, locality 9, Bergisches Land, Germany (coll. Ebbighausen). Holotype: figured herein as Fig. 4D.

TYPE LOCALITY. Bücheler Schichten, Middle Devonian (Givetian), Herrenstrunden, locality 9, Bergisches Land, Germany.

DIAGNOSIS. As for genus.

DESCRIPTION. Small high-spired, dextrally coiled shell, up to 13 whorls present. Sides of shell nearly straight, whorl profile distinctly convex; maximum convexity close to both upper and lower sutures. Whorl profile nearly flat at mid-whorl. Sutures moderately deep. Lateral part of the whorl curves uniformly to base part, forming a smooth curvature without any angulation. Shell base rounded and anomphalous. Shell ornamentation consists of asymmetrically bent collabral costae being crossed in the mid-whorl

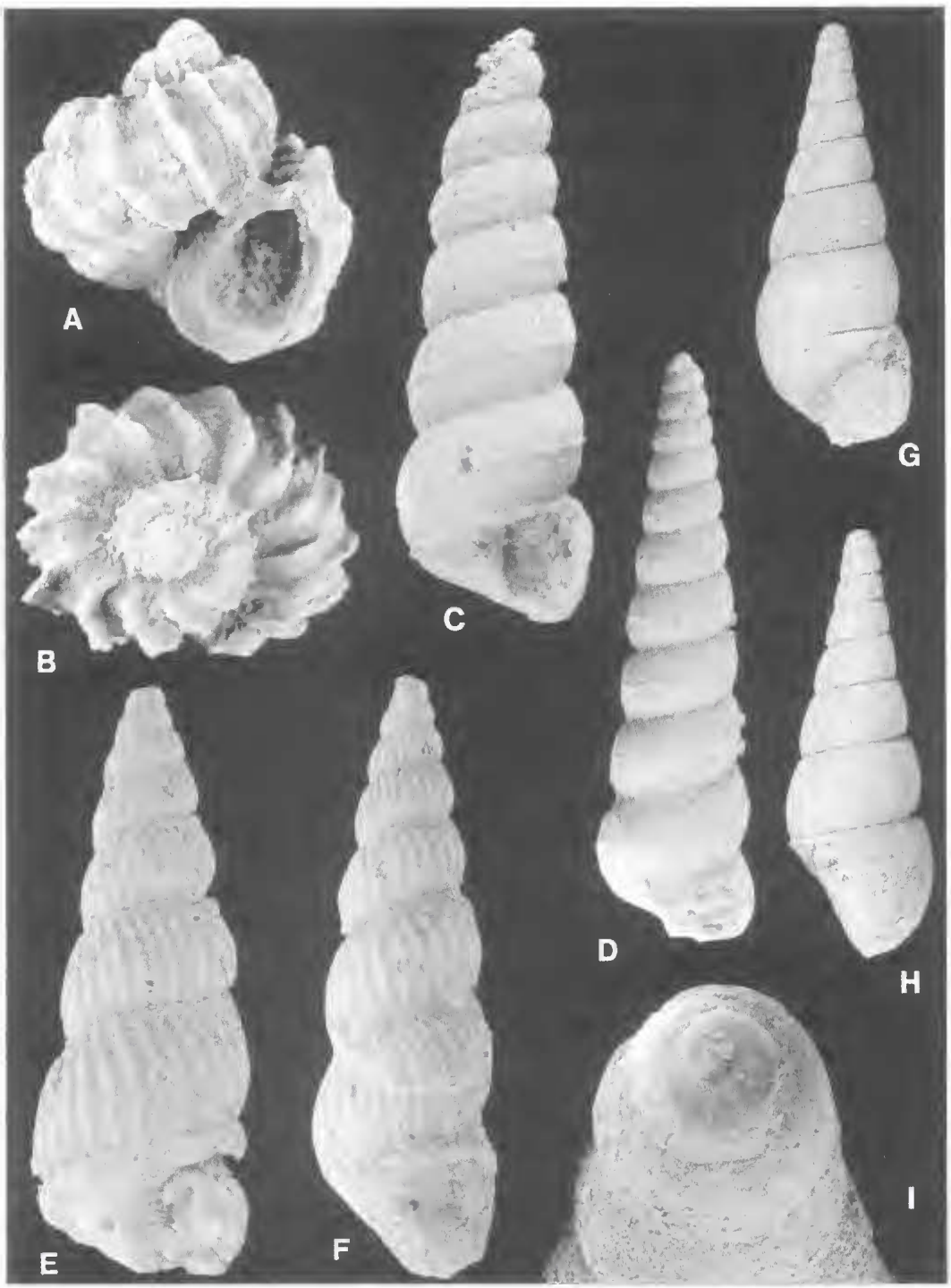


FIG. 4. A, B, *Paffrathia lotzi* sp. nov., Holotype; A, apertural view ×4.5; B, apical view ×4.5. C, D, *Cookiloxa pulchra* sp. nov.; C, Paratype A, lateral view ×14; D, Holotype, lateral view ×9. E, F, *Palaeozygopleura (Rheinozyga) retrostriatum* (Kirchner, 1915) comb. nov.; E, lateral view showing the regularly spaced orthocline costae ×15; F, lateral view of larger shell ×9. G-I, *Heteroloxonema moniliforme* (Goldfuss, 1842) comb. nov.; G, apertural view ×3.4; H, lateral view ×3.4; I, oblique view showing an early whorl × 125.

by one spiral costa. Beginning at the upper suture, the collabral costae run in prosocline direction, gradually curve in an orthocline direction, and then in opisthocline direction near the mid-whorl forming a wide, asymmetrical arched sinus.

REMARKS. Shape of the collabral costae in *Cookiloxa pulchra* sp. nov. resemble those of some species of *Palaeozygopleura* Horný, 1955 (i.e. the Early Devonian *P. chlupaci* Frýda, 1993, *P. devonicans* (Perner, 1907) and the Middle Devonian, *P. hamiltonae* (Hall, 1861)). Spiral costa in *Cookiloxa pulchra* is most probably just elements of the shell ornamentation and not a narrow selenizone. Without knowledge of the initial part of the shell *Cookiloxa* gen. nov. its higher taxonomic position remains questionable.

PALAEOZYGOPLEURIDAE
Horný, 1955

**Palaeozygopleura** Horný, 1955
**Palaeozygopleura (Rhenozyga)** subgen. nov.

TYPE SPECIES. *Loxonema retrostriatum* Kirchner, 1915 (herein Fig. 4E,F).

ETYMOLOGY. *Rhenozyga* referring to Latin *Rhenus*, for the river Rhine.

DIAGNOSIS. *Palaeozygopleura* with orthocline or slightly opisthocyrt collabral costae; whorl between sutures strongly arched; shell cyrtoconoid or with straight sides.

REMARKS. *Palaeozygopleura (Rhenozyga)* subgen. nov. differs from all other subgenera of *Palaeozygopleura* by the shape of its collabral costae which are orthocline or slightly opisthocyrt. *Palaeozygopleura (Rhenozyga)* may be distinguished by its strongly arched whorls which are also higher than in all other subgenera of *Palaeozygopleura*. The orthocline or slightly opisthocyrt shape of costae resemble that of *Devonozyga* Horný, 1955. The whorls in *Devonozyga* Horný, 1955 are distinctly shouldered and in the median region flattened, in contrast to that in the *Palaeozygopleura (Rhenozyga)* subgen. nov. which has strongly arched whorl sides. Blodgett (1992) described a new genus *Alaskozygopleura* based on the Eifelian *Alaskozygopleura crassicostata* Blodgett, 1992 which he tentatively placed in the family Pseudozygopleuridae Knight, 1930. *Palaeozygopleura (Rheinozyga)* subgen. nov. resembles *Alaskozygopleura* in its shell ornamentation, but the former taxon may be distinguished from the latter its much narrower shell and circular aperture. Blodgett (1992) noted broad variability of his *Alaskozygopleura crassicostata*, but all of the figured shells of his species have ovoid, adapically narrower apertures, considerably wider shells and higher whorls than *Palaeozygopleura (Rhenozyga) retrostriatum* (Kirchner, 1915).

Unfortunately there are no data about the early shell in the Givetian species of *Palaeozygopleura (Rhenozyga)* subgen. nov. All other subgenera of *Palaeozygopleura* have protoconchs of the archaeogastropod type (Frýda & Bandel, 1997). The placement of *Rhenozyga* in the genus *Palaeozygopleura* should be proved by type of its protoconch. Besides the type species, *Palaeozygopleura (Rhenozyga) retrostriatum* (Kirchner, 1915), several other *'Loxonema'* species from the Middle Devonian of Germany like *Loxonema spiraglobosum* Kirchner, 1915 may belong to the new *Palaeozygopleura (Rhenozyga)*. *Palaeozygopleura machemyi* Cook, 1997 from the Middle Devonian of Australia also is transferred to the new *Palaeozygopleura (Rhenozyga)*. A detailed study of all Middle Devonian species resembling the genus *Palaeozygopleura* as well as comparison with the Eifelian *Alaskozygopleura crassicostata* Blodgett, 1992 is in preparation.

? HETEROSTROPHA Fischer, 1885

**Heteroloxonema** gen. nov.

TYPE SPECIES. *Turritella moniliformis* Goldfuss, 1844.

ETYMOLOGY. A combination of the generic name *Loxonema* and the prefix *hetero-* because of the presumed heterostrophic coiling of its early shell.

DIAGNOSIS. Slender, high-spired and multiwhorled shell; first whorl planispirally or slightly sinistrally coiled; shell apex blunt and dome-like; teleoconch sides slightly convex; whorl profile gently convex between shallow, but with distinct sutures; teleconch surface smooth.

REMARKS. The smooth teleoconch of *Heteroloxonema* gen. nov. resembles that of many loxonematids including *Loxonema*, but may be distinguished by its dome-like shell apex formed by planispirally or slightly sinistrally coiled early whorl. All known Devonian loxonematoidean gastropods such as *Katoptychia* Perner, 1907, *Stylonema* Perner, 1907, *Palaeozygopleura (Palaeozygopleura)* Horný, 1955, *Palaeozygopleura (Palaeozyga)* Horný, 1955, and *Palaeozygopleura (Bohemozyga)* Frýda & Bandel, 1997 have an acute shell apex which is formed by the archaeogastropod-type protoconch. *Heteroloxonema* gen. nov. having a planispirally

or slightly sinistrally coiling of its early whorl may be distinguished by this character from all known loxonematoideans. This character distinguishes *Heteroloxonema* gen. nov. also from the genus *Donaldina* Knight, 1933, based on the Carboniferous *Aclisina grantonensis* Donald, 1898. According to Knight (1941), the latter species has 'earliest two whorls free from the spire, the first whorl planispirally coiled and tilted', in contrast to the blunt and dome-like shell apex of *Heteroloxonema*. In addition, the shells of the type species are ornamented by numerous spiral lirae (see Knight 1941: pl. 48, fig. 3a-e). *Heteroloxonema moniliforme* (Goldfuss, 1844) from the Middle Devonian of Germany is the only known species.

**Heteroloxonema moniliforme**
(Goldfuss, 1844)
(Fig. 4G-I)

*Turritella moniliformis*. Goldfuss 1844, p. 103, pl. 196, fig. 1.
*Loxonema moniliforma* (Goldfuss), Bandel 1994, pl. 4, figs. 9-10.
*Donaldina moniliforma* (Goldfuss), Nützel,1997: 209, pl. 34 S-T.

MATERIAL. 13 complete shells from the Unterthal, locality 63, Paffrath area, Germany (coll. Ebbighausen).

DIAGNOSIS. As for genus.

DESCRIPTION. Medium sized, high-spired, dextrally coiled shells having at least 9 whorls. Shell sides slightly convex; sutural slope approximately 10°. The first whorl planispirally or slightly sinistrally coiled. Shell apex blunt and dome-like. Whorl profile gently convex and slightly flattened in median region; width of whorl almost twice of its height. Sutures are shallow but distinct. Shell base anomphalous, teleoconch surface smooth.

REMARKS. Bandel (1994) figured the early whorl in *Heteroloxonema moniliforme* (Goldfuss, 1844) which is, according to his observation, sinistrally coiled. For this reason he considered it to be a member of the Heterostropha. If his interpretation is correct, then *Heteroloxonema moniliforme* represents the oldest known member of this subclass (Bandel, 1994) and also the only heterostrophid gastropod older than the Frasnian/Famennian mass extinction. Nevertheless, no protoconch/teleoconch boundary was hitherto observed in this species.

ACKNOWLEDGEMENTS

I thank Dr Volker Ebbighausen for providing material from his collection. This publication is based on my studies of the Siluro-Devonian gastropods supervised by Klaus Bandel (Universität Hamburg), partly sponsored by the U.S.-Czechoslovak Science and Technology Joint Fund in cooperation with the Czech Geological Survey and U.S. Geological Survey under Project Number 95057. I gratefully thank Robert B. Blodgett (Oregon State University) and Alex G. Cook (Queensland Museum) for their useful critical remarks to the manuscript and improving its language.

LITERATURE CITED

ARCHIAC, E.J.A.D. & VERNEUIL, E.P.D. 1842. On the fossils of the older deposits in the Rheinish Province. Transactions of the Geological Society of London 6: 303-410.

BANDEL, K. 1994. Triassic Euthyneura (Gastropoda) from St.Cassian Formation (Italian Alps) with a discussion on the evolution of the Heterostropha. Freiberger Forschungsheft C 452: 79-100.

BANDEL, K. & FRÝDA, J. 1998 Position of Euomphalidae in the system of the Gastropoda. Senckenbergiana Lethaea 78 (1/2): 103-131.

1999. Notes on the evolution and higher classification of the subclass Neritimorpha (Gastropoda) with the description of some new taxa. Geologica et Palaeontologica 33: 219-235.

BATTEN, R.L. 1966. The lower Carboniferous gastropod fauna from the Hotwells limestone of Compton Martin, Somerset, part I+II. Palaeontographical Society Monographs 119: 1-109.

1972. Permian gastropods and chitons from Perak, Malaysia. Part 1, Chitons, bellerophontids, euomphalids and pleurotomarians. Bulletin of the American Museum of Natural History 147 (1): 5-44.

1985. Permian gastropods from Perak, Malaysia. Part 3, The murchisoniids, cerithiids, loxonematids, and subulitids. American Museum Novitates 2829: 1-62.

BLODGETT, R.B. 1992. Taxonomy and paleobiogeographic affinities of an early Middle Devonian (Eifelian) gastropod faunule from the Livengood Quadrangle, east-central Alaska. Palaeontographica, Abteilung A: 221: 125-168.

1993. *Dutrochus*, a new microdomatid (Gastropoda) genus from the Middle Devonian (Eifelian) of west-central Alaska. Journal of Paleontology 62(2): 194-197.

BLODGETT, R.B. & JOHNSON, J.G. 1992. Early Middle Devonian (Eifelian) gastropods of central Nevada. Palaeontographica, Abteilung A:222: 83-139.

1995. *Merriamites*, a new name for the bellerophontid gastropod genus *Merriamella* Blodgett and Johnson. Journal of Paleontology 69(3): 608.

BLODGETT, R.B. & ROHR, D.M. 1989. Two new Devonian spine-bearing pleurotomariacean

gastropod genera from Alaska. Journal of Paleontology 63(1): 47-52.

BLODGETT, R.B., ROHR, D.M. & BOUCOT, A.J. 1988. Lower Devonian gastropod biogeography of the Western Hemisphere. In Embry, Macmillan & Glass Devonian of the world; proceedings of the Second International symposium on the Devonian System; Volume III, Paleontology, paleoecology and biostratigraphy. Memoir Canadian Society of Petroleum Geologists 14: 281-294.

1990. Early and Middle Devonian gastropod biogeography. Memoir Geological Society of London 12: 277-284.

CHAPMAN, F. 1916. New or little-known Victorian fossils in the National Museum. Part XIX. The Yeringian gastropod fauna. Proceedings of the Royal Society of Victoria, 29 (I):75-103.

COOK, A.G. *Fletcherviewia septata*; a new high-spired, septate gastropod from the Devonian of North Queensland. Journal of Paleontology 67(5): 816-821.

1997. Gastropods from the Burdekin Formation, Middle Devonian, North Queensland. Memoirs of the Queensland Museum 42(1): 37-49.

COOK, A.G. & CAMILLERI, N. 1997. Middle Devonian gastropods from the Broken River Province, North Queensland. Memoirs of the Queensland Museum 42(1): 55-79.

DONALD, J. 1892. Notes on some new and little-known species of Carboniferous *Murchisonia*. Quarterly Journal of the Geological Society of London: 562-575.

1895. Notes on the genus *Murchisonia* and its allies; with a revision of the British Carboniferous species, and descriptions of some new forms. Quarterly Journal of the Geological Society of London 51: 210-234.

FRÝDA, J. 1992. Mode of life of a new onychochilid mollusc from the Lower Devonian of Bohemia. Journal of Paleontology 66(2): 200-205.

1993. Oldest representative of the family Palaeozygopleuridae (Gastropoda) with notes on its higher taxonomy. Journal of Paleontology 67(5): 822-827.

1998a. Classification and Phylogeny of Devonian Gastropods. Unpubl. thesis, Universität Hamburg, Hamburg.

1998b. Did the ancestors of higher gastropods (Neritimorpha, Caenogastropoda, and Heterostropha) have an uncoiled shell? Abstracts, 13th International Malacological Congress, Washington DC: 107.

1998c. Some new and better recognized Devonian gastropods from the Prague Basin (Bohemia). Bulletin of the Czech Geological Survey 73(1): 41-49.

1998d. Some new and better recognized Devonian gastropods from the Prague Basin (Bohemia): part II. Bulletin of the Czech Geological Survey 73(4): 355-363.

1999a. Three new gastropod genera from the Early Devonian of Bohemia. Bulletin of the Czech Geological Survey 74(1): 31-38.

1999b. Higher classification of Paleozoic gastropods inferred from their early shell ontogeny. Journal of the Czech Geological Society, Barrande volume, 44(1-2): 137-153.

FRÝDA, J. & BANDEL, K. 1997. New Early Devonian gastropods from the *Plectonotus (Boucotonotus) - Palaeozygopleura* Community in the Prague Basin Bohemia). Mitteilungen aus dem Geologisch-Palaeontologischen Institut der Universität Hamburg 80: 1-58.

FRÝDA, J. & MANDA, Š. 1997. A gastropod faunule from the *Monograptus uniformis* graptolite Biozone Early Lochkovian, Early Devonian) in Bohemia. Mitteilungen aus dem Geologisch-Palaeontologischen Institut der Universität Hamburg 80: 59-122.

GOLDFUSS, A. 1844. Petrefacta Germaniae, 3. (Dusseldorf).

GORDON, M. & YOCHELSON, E.L. 1987. Late Mississippian Gastropods of the Chainman Shale, west-central Utah. United States Geological Survey Professional Paper 1368: 1-112.

GUBANOV, A.P., BLODGETT, R.B. & LITOCHKIN, V.M. 1995. Early Devonian (Pragian) gastropods from Kyrgyzstan (Central Asia). Journal of Paleontology, 69: 431-440.

HOARE, R.D. & STURGEON, M.T. 1978. The Pennsylvanian gastropod genera *Cyclozyga* and *Helminthozyga* and the classification of the Pseudozygopleuridae. Journal of Paleontology 52 (4): 850-858.

HORNÝ, R. 1955. Palaeozygopleuridae nov. fam. Gastropoda) ze stredoceského devonu. Sborník Ustredního ústavu geologického oddíl paleontologický 21: 17-159.

1992. New Lower Devonian Gastropoda and Tergomya (Mollusca) of Bohemia. Casopis Narodniho Muzea v Praze, 1-4: 99-110.

1994. Shell morphology and ontogeny of the Lower Devonian Murchisoniacean gastropod *Branzovya maturoglabra* (Murchisoniacea). Casopis Narodniho Muzea v Praze, 1-4: 81-89.

HORNÝ, R. & IORDAN, M. 1993 Silurian and Devonian Gastropoda of Romania. Casopis Narodniho Muzea v Praze, 1-4:71-85.

KASE, T. & NISHIDA, T. 1986. A Middle Devonian gastropod faunule from the Nakazato Formation of Kitakami, Northeast Japan. Bulletin of the National Science Museum C12: 73-89.

1988. Two new Middle Devonian gastropods from the Nakazato Formation of Kitakami, Northeast Japan. Saito Ho On Kai Museum Special Publication 2: 257-263.

KIRCHNER, H.S. 1915. Mitteldevonische Gastropoden von Soetenich in der Eifel. Verhandlungen des Naturhistorischen Vereins der preussischen Rheinlande und Westfalens II: 189-261.

KNIGHT, J.B. 1934. The gastropods of the St. Louis, Mo., Pennsylvanian outlier. The Euomphalidae and Platyceratidae. Journal of Paleontology 8(2): 139-166.

1941. Paleozoic gastropod genotypes. Geological Society, Special Papers 32: 1-510.

1945. Some new genera of Paleozoic Gastropoda. Journal of Paleontology 19(6): 573-587.

1956. New families of Gastropoda. Journal of the Washington Academy of Sciences 46(2): 41-42.

KNIGHT, J.B., COX, L.R., MYRA, A., BATTEN, R.L., YOCHELSON, E.L. & ROBERTSON, R. 1960. Systematic descriptions Archaeogastropoda. Pp. 169-324. Treatise on Invertebrate Paleontology. (Geological Society of America, Inc. and University of Kansas Press: Lawrence, Kansas).

KOKEN, E. 1889. Über die Entwicklung der Gastropoden vom Cambrium bis zur Trias. Neues Jahrbuch für Mineralogie, Geologie und Palaeontologie, 6: 305-484.

1897. Die Leitfossilien, ein Handbuch für den Unterricht und das Bestimmen von Versteinerungen. 1-848. Leipzig.

KONINCK, L.G. d. 1881. Faune du Calcaire Carbonifere de la Belgique, Gasteropodes. Annales du Musee Royal d'Histoire Naturelle de Belgique, VI: 1-170.

1883. Faunc du calcaire carbonifére de la Belgique 4 partie, Gastéropodes suite et fin). Musée Royal d'Histoire Naturclle de Belgiquc Annales, Série Paléontologique 8: 1-240.

LINSLEY, R.M. 1968. Gastropods of the Middle Devonian Anderdon limestone. Bulletins of American Paleontology, 54(244): 333-465.

LOTZ, H. 1900. Die Fauna des Massenkalks der Lindener Mark bei Giessen. 205-216. (Marburg).

NÜTZEL, A. 1997: Über die Stammesgeschichte der Ptenoglossa (Gastropoda). Geowissenschaften. Abhandlungen E 26: 1-229.

OEHLERT, D. & OEHLERT, P. 1888. Descriptions de quelques especes dévoniennes du département de la Mayenne. Bulletin de la Société d'Etudes Scientifiques d'Angers 1887: 65-120.

PAECKELMANN, W. 1922. Der mitteldevonische Massenkalk des Bergischen Landes. Abhandlungen der Preussischen Geologischen Landesanstalt 91: 1-112.

PERNER, J. 1903, 1907, 1911. Gastéropodes. In J. Barrande, Systeme silurien du centre de la Boheme. IV: 1-390. (Praguc).

ROEMER, F. 1876. Lethaea palaeozoica. Atlas. (Hannover).

ROLLINS, H.B., ELDREDGE, N. & SPILLER, J. 1971. Gastropoda and Monoplacophora of the Solsville member Middle Devonian, Marcellus Formation) in the Chenango valley, New York State. Bulletin of the American Museum of Natural History 144(2): 133-170.

SCHLOTHEIM, E.F. 1820. Die Petrefactenkunde auf ihrem jetzigen Standpunkte durch die Beschreibung seiner Samlung versteinertcr und fossier Uberreste des Thier- und Pflanzenreichs der Vorwelt erlautert. 1-436. (Gotha).

1822. Nachtrage zur Petrefactekunde. 1-100. (Gotha).

STAUFFER, C.R. 1909. The Middle Devonian of Ohio. Bulletin of Geological Survey of Ohio, Fourth series 10: 160-194.

VOSTOKOVA, V.A. 1961. Paleozoiskie gastropody Novoj Zemli i ostrova Vajgac. Sbornik statei po paleontologii i biostratigrafii. Leningrad. 5-25.

1966. Devonian and Carboniferous gastropods from the Rudnyj Altaj Moutains. - Voprosy Paleontologii Tom V: 38-52.

WENZ, W. 1939-1943. Gastropoda, Handbuch der Palaeozoologie, 1-6: 1-1639. (O.H. Schindewolf).

WHIDBORNE, G.F. 1891. A monograph of the Devonian fauna of the south of England. Part III. The fauna of the limestones of Lummaton, Wolborough, Chircombe Bridge, and Chudleigh. Palaeontographical Society: 155-250.

1892. A monograph of the Devonian fauna of the south of England. Part IV. The fauna of the limestones of Lummaton, Wolborough, Chircombe Bridge, and Chudleigh. Palaeontographical Society: 251-344.

YOCHELSON, E.L. 1953. *Jedria*, a new subgenus of *Naticopsis*. Journal of the Washington Academy of Sciences 43: 3-65.